

AMENDMENTS TO THE SPECIFICATIONS

Page 1, please amend the title as follows:

~~An optical~~ Optical module, ~~an~~ optical communication apparatus and ~~a~~-optical transceiver module

Page1, please amend paragraph [0003] as follows:

[0003] ~~A configuration of an optical transceiver have been well known that an optical sub-assembly installing an optical device is electrically connected to a circuit board, on which electronic devices such as a driver circuit and/or a processing circuit, with a flexible printed circuit. It is well known as a configuration of an optical transceiver that an optical sub-assembly including an optical device is electrically connected with a flexible printed circuit to a circuit board where electronic devices such as a driver circuit and/or a signal processing circuit are installed thereon.~~ For example, Japanese patent published as H11-196055 and United States patent issued by USP 5,802,711 have disclosed such configuration.

Page 1, please amend paragraph [0004] as follows:

[0004] Another configuration ~~for~~ of the optical transceiver is known in which,~~that~~ the housing ~~thereof~~ is divided into two parts, i.e., an upper housing and a lower housing ~~housings, is known.~~ One of the parts installs a circuit board for the optical transmitting function while the other ~~of parts~~ part installs a circuit board for the optical receiving function. Japanese patent published as H08-037500 has disclosed such configuration.

Page 2, please amend paragraph [0006] as follows:

[0006] The optical transceivers mentioned above use optical sub-assemblies therein and the optical sub-assembly has a co-axial shape. However, such optical ~~transceivers~~ ~~transeeiver~~ ~~having with a~~ co-axial optical sub-assembly ~~have~~ ~~has, in the other side, a subject a problem to~~ ~~increase~~ raise the assembling cost.

Please amend paragraph [0009] bridging pages 2 and 3 as follows:

[0009] The housing may ~~includes~~ include a base and a cover. The base has a mounting region, the optical device is mounted thereon. The cover has the cavity. The cover and the base secure the fiber assembly therebetween. The cover may include a groove for securing the fiber assembly therein. The base may also include a groove for securing the fiber assembly therein. The grooves provided in the base or the cover may include a first groove and a second groove extending from the first groove. The fiber assembly includes an optical fiber and a ferrule covering the optical fiber, and the first groove may secure the optical fiber while the second groove may secure the ferrule.

Page 3, please amend paragraph [0010] as follows:

[0010] The optical module may further ~~includes~~ include a bench for mounting the optical device and for securing the fiber assembly between the cover. The bench is mounted on a receiving portion of the base.

Page 5, please amend paragraph [0029] as follows:

[0029] Referring to FIG. 1 and FIG. 2, the optical module 1 includes a first substrate 3, an electronic device 5 mounted on the first substrate 3, an optical device 7 electrically connected to the electronic device 5, a fiber assembly 9 optically coupled to the optical device ~~7~~ 5, and a housing 11. The housing comprises a base 13 and a cover 15, on the base 13 is provided a mounting region 11a, a groove 11c and an opening 11e, while in the cover 15 is provided a cavity 11b and a groove ~~11d~~ 11d. The mounting region mounts the optical device ~~7~~ thereon. The cavity 11b receives the electronic device 5 and the optical device 7. Two grooves 11c and lid are continued to the cavity 11b, and secure the fiber assembly~~[[,]]~~ 9. The first substrate 3 is disposed in the opening 11e. The base 13 and the cover 15 may be made of resin.

Page 6, please amend paragraph [0032] as follows:

[0032] The opening 11e in the base ~~13~~ 13 may include guide faces 22a to 22d to receive the first substrate 3 therein. On the other hand, the first substrate 3 has sides 3a to 3d. When the first substrate 3 is put in the opening 11e, the sides 3a to 3d of the first substrate 3 slide on the respective guide faces 22a to 22d of the base ~~13~~ 13.

Page 6, please amend paragraph [0033] as follows:

[0033] Referring to FIG. 3A and FIG. 3B, the electronic device 5, the optical device 7, the optical fiber assembly 9, the groove 11c, the mounting region 11a, and the opening 11e are arranged along an axis. Further, the groove 11c has an abutting surface 19c adding to the faces 19a and 19b, to which the tip 9a of the optical fiber 9 is abutted, accordingly the optical device 7 and the optical fiber 9 may be coupled in a an effective position with each other. This

configuration of the optical module 1, especially in the base 13 thereof, realizes a passive alignment between the optical fiber 9 and the optical device 7.

Page 6, please amend paragraph [0034] as follows:

[0034] Referring to FIG. 1 and FIG. 2 again, the optical communication apparatus 23 includes the optical module 1, a second substrate 27, a wiring member 25 for connecting the optical module 1 to the second substrate 27, and further electronic device 29 mounted on the second substrate 27. The wiring member 25 has an end 25a connected to the first substrate 3 of the optical module 1 and the other end 25b connected to the second substrate 27. Thus, the other electronic device 29 is connected to the electronic device ~~25~~ 5 on the first substrate 3 via the wiring member 25.

Page 7, please amend paragraph [0036] as follows:

[0036] The optical device 7 may be a light-emitting device, and the electronic device 5 may be a driver for driving the light-emitting device 7. The other electronic device ~~27~~ 29 may be a signal-processor for providing the driving-signal to the driver 5. The light-emitting device 7 may be a semiconductor laser diode, for instance a Fabry-Perot type laser diode or a distributed feedback (DFB) laser diode, a semiconductor optical amplifier, a semiconductor modulator, and a semiconductor optical integrated device. The semiconductor optical integrated device includes a light-emitting device and a light-modulating device, they are formed integrally in a unity body. The signal-processing device may include a de-multiplexer.

Page 7, please amend paragraph [0037] as follows:

[0037] The additional substrate 27 of the present optical communication apparatus 23 ~~enables to~~ may install more electronic devices compared to the conventional apparatus.

Moreover, the configuration of the optical module 1 can be maintained in a simplified form because the additional substrate 27 is disposed outside of the optical module 1 and electrically connected via the wiring member 25.

Page 7, please amend paragraph [0038] as follows:

[0038] The ferrule 20 maybe made of ceramic or plastic, and the optical fiber 17 may be a single mode fiber or a multi-mode fiber. The multi-mode fiber may increase tolerance of the optical coupling efficiency between the optical fiber 17 and the optical device 7, and also that between the external fiber and the internal fiber of the optical module 1.

Please amend paragraph [0039] bridging pages 8 and 9 as follows:

[0039] The housing 11 provides a hollow Min the outer surface thereof, namely the bottom surface 11g thereof opposite to the primary surface where the optical device is mounted thereon, to receive the wiring member 25. The hollow 11f, the shape of which is a groove or a bore, prevents the wiring member 25 from extruding from the outer surface of the housing 11.

Page 8, please amend paragraph [0040] as follows:

[0040] FIG. 4 shows a modified optical module 33, which further includes a light-receiving device 10 between the optical device 8 and the electronic device 5 for monitoring light emitted from the optical device 8. The light-receiving device 10 may be optically coupled with the optical device 8 via the base 14 where both devices 8 and 10 are mounted thereon. The optical device 8 ~~as~~ is electrically connected to the wiring pattern 37a formed on the first substrate 4 and to the electronic device 5 via the wiring pattern 35a formed on the base 14. The electronic device 10 is electrically connected to the wiring pattern 37b formed on the first substrate 4 and to another wiring pattern 35b formed on the base 14.

Page 8, please amend paragraph [0044] as follows:

[0044] In the optical module 41 according to the second embodiment, the optical fiber 57 includes a first portion 57a and a second portion 57b different to those shown in the first embodiment. The ferrule 59 secures and covers the second portion 57b of the optical fiber 57. The grooves 51c and 51d, each formed in the base ~~35~~ 53 and the cover 55, respectively, include a pair of surfaces 59a and 59b, and/or another pair of surfaces 61a and 61b. These surfaces, 59a, 59b, 61a and 61b, secures the ferrule 59 of the fiber assembly 49, thereby optically coupling the optical fiber 57 with the semiconductor optical device 47.

Page 9, please amend paragraph [0046] as follows:

[0046] FIG. 7 shows an arrangement in which the optical device 47, for example the light-receiving device, is coupled to the optical fiber 57. The base 53 includes a ~~a~~ an additional groove 64 ~~through~~ through which the optical fiber 57 may be coupled with the optical device

47. The additional groove 64 has a light-reflecting surface 64a in the end thereof. The light LA emitted from the tip of the optical fiber 57 is reflected at the light-reflecting surface 64a and converted to the light LB directed toward the optical device 47. The reflected light LB enters the incident surface 47a of the optical device 47 via the lens 47b monolithically formed on the incident surface ~~47b~~ 47a thereof, and finally reaches the active region 47c. The optical module 41 provides ~~an~~ a configuration preferably fitting to the passive alignment.

Page 9, please amend paragraph [0047] as follows:

[0047] The electronic device ~~5~~ 45 in this embodiment may be a pre-amplifier for amplifying signal output from the optical device 47. The other electronic device 29 installed on the second substrate 27 may be a main amplifier for processing the signal output from the pre-amplifier 45. The light-receiving device 47 may be a pin photodiode or an avalanche photodiode.

Please amend paragraph [0050] bridging pages 9 and 10 as follows:

[0050] The optical module 81 has a base 93 having a modified shape and a bench 25 97. The base 93 includes a hollow 91a for receiving the bench 97. The hollow 91a has the end face 91d, which intersects the optical axis, for defining the ~~portion~~ position of the bench 97 in the hollow 91a. The ~~bench~~ base 93 also has the opening 91e for receiving the first substrate 3. The first substrate 3 is inserted and fitted in the opening 91e of the base 93. Therefore, the bench 97 and the first substrate 3 ~~is~~ are aligned with each other on the base 93. On the bench 97, the optical device ~~47~~ 7 and the fiber assembly ~~57~~ 49 are aligned with each other.

Page 10, please amend paragraph [0051] as follows:

[0051] The bench 97 has a first rove 99 and a second grove 101 both arranged along the axis. The first grove 99 includes a pair of surfaces 99a and 99b for supporting the ferrule 59, while the second grove 101 includes a pair of surfaces 101a and 101b for supporting the optical fiber 57. The second grove 101 further has an end surface 103. The tip ~~57e~~ 57c of the optical fiber 57 is abutted to the end surface 103, thereby defining the position thereof on the bench 97 and optically aligning the optical fiber 57 with the optical device 7.

Please amend paragraph [0054] bridging pages 10 and 11 as follows:

[0054] The electronic device 5 and the other electronic devices 29, 31 are mounted on the first 3 and the second 27 substrate, respectively, as shown in FIG. 9C. Subsequent to the mounting of the electronic devices 29, 31, wiring patterns on the substrate 3 and 27 are connected to the electronic device on the first substrate and to those 29 and 31 on the second substrate with bonding-wires. Next the cover 15 having the cavity 11b and the base 13 having the opening 11e are assembled with first substrate 3.

Page 12, please amend paragraph [0058] as follows:

[0058] FIG. 12A is a ~~plane~~ plan view showing another substrate unit 131 of according to the present invention. The substrate unit 131 includes the first to the third substrates 133, 135 and 137, and the first and the second wiring member 139 and 141. The first wiring member 139, which is a flexible member, connects the first substrate 133 to the ~~third~~ second substrate 135, while the second wiring member 141, which is also a flexible member, connects the second substrate 135 to the third substrate 137. On the first substrate 138 is mounted the electronic

device 140, and on the second substrate 135 is mounted the other electronic device 143, 145, 147 and 149. On the third substrate 137 is mounted the electronic device 151. The electronic device 140 mounted on the first substrate is connected to the other electronic device 143 via the wiring member ~~138~~ 139, and the electronic device 151 is connected to the other electronic device 147 via the wiring member 141. One edge of the second substrate 135 provides a plurality of lead pins 150 connected to the electronic devices 143 and 147. In this embodiment, the first and the second wiring member, 138 and 139, may be a flexible printed circuit.

Please amend paragraph [0059] bridging pages 12 and 13 as follows:

[0059] FIG. 12B is a plan view of the optical module 152 and the optical transmitting apparatus 153 using the unit 131 of FIG. 12A. The optical module 152 has single base commonly provided to the optical transmitting portion and the optical receiving portion. On the base 155 is mounted the first and the second optical devices 163 and 165, and is formed two openings 155b ~~ad~~ and 155c. In the opening 155b is positioned by the first substrate 133, while in the opening 155c is inserted by the third substrate ~~133~~ 137. Further, two fiber ~~assembly~~ assemblies 161a and 161b are also mounted on the base 155, which are optically coupled with respective optical devices 161a and 161b via the base 155. The cover 157 is disposed so as to cover two optical devices 163 and 165, two electronic devices 140 and 151, and two fiber assemblies 161a and ~~16b~~ 161b.

Page 13, please amend paragraph [0062] as follows:

[0062] FIG. 13A is a plan view showing still another substrate unit 132, and FIG. 13B is a plan view showing the optical communication apparatus 154 using the substrate unit 132. The

substrate unit 132 according to the present embodiment has a third substrate 138 adequate for the optical sub-assembly 169 having the co-axial shape. The optical sub-assembly 169 with the co-axial shape comprises a stem 169b, a lens cap 169c, a first sleeve 169d, and a second sleeve 169e. The second sleeve 169d receives and secures the ferrule 169f. A plurality of lead pins 169a is extended from the stem 169b, to which the third substrate 138 is electrically connected. The optical device 151 is mounted on the stem 169b, thus coupled to the optical fiber 169g provided in the ferrule 169f.